CLAIMS:

1. A dispersion management optical lithography crystal for managing dispersion below 160 nm, said dispersion management optical lithography crystal comprised of a fluoride crystal having a 157 nm transmission > 85% and a refractive index wavelength dispersion $dn/d\lambda < -0.003$ at 157 nm.

2. A dispersion management optical lithography crystal as claimed in claim 1, wherein said fluoride crystal has a 157 nm refractive index $n > 1.56$.

3. A dispersion management optical lithography crystal as claimed in claim 1, wherein said fluoride crystal has a 157 nm refractive index temperature coefficient $dn/d\lambda > 8 \times 10^{-6}/°C$.

4. A dispersion management optical lithography crystal as claimed in claim 1, wherein said crystal comprises a bandwidth dispersion managing optical element.

5. A dispersion management optical lithography crystal as claimed in claim 1, wherein said crystal comprises a spatial dispersion managing optical element.

6. An optical lithography crystal as claimed in claim 1, wherein said fluoride crystal has an oxygen contaminant content of less than 20 ppm by weight.

7. A dispersion management optical lithography crystal for managing dispersion below 160 nm, said dispersion management optical lithography crystal comprised of an isotropic alkali metal alkaline earth metal mixed crystal, said alkali metal alkaline earth metal mixed crystal material having a formula of MRF_3 where M is an alkali metal chosen from the alkali metal group consisting of Li, Na, and K , and R is an alkaline earth metal chosen from the alkaline earth metal group consisting of of Ca, Sr, Ba and Mg and said isotropic alkali metal alkaline earth metal mixed crystal having a 157 nm transmission > 85% .

8. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $KMgF_3$.

9. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $KSrF_3$.

10. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $KBaF_3$.

11. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $KCaF_3$.

12. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $LiMgF_3$.

13. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $LiSrF_3$.

14. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $LiBaF_3$.

15. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $LiCaF_3$.

16. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $NaMgF_3$.

17. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $NaSrF_3$.

18. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $NaBaF_3$.

19. An optical lithography crystal material as claimed in claim 7, wherein said alkali metal alkaline earth metal mixed crystal material is comprised of $NaCaF_3$.

20. A dispersion management optical lithography crystal for managing dispersion below 160 nm, said dispersion management optical lithography crystal comprised of an isotropic alkaline earth metal mixed crystal, said alkaline earth metal mixed crystal material having a formula of $(M1)_x(M2)_{1-x}F_2$ where M1 is a first alkaline earth metal chosen from the alkaline earth metal group consisting of Ca, Sr, and Ba, and M2 is a second alkaline earth metal chosen from the alkaline earth metal group consisting of Ca, Sr, and Ba, and x is between 0 and 1 , and M2 is an alkaline earth metal different from M1 and said isotropic alkaline earth metal mixed crystal having a 157 nm transmission > 85% .

21. An optical lithography crystal material as claimed in claim 20, wherein M1 is Sr and M2 is Ba.

22. An optical lithography crystal material as claimed in claim 20, wherein M1 is Sr and M2 is Ba and x is 0.5.

23. An optical lithography crystal material as claimed in claim 20, wherein M1 is Sr and M2 is Ba and x is 0.75.

24. An optical lithography crystal material as claimed in claim 20, wherein M1 is Sr and M2 is Ba and x is in the range from 0.5 and 0.75.

25. An optical lithography crystal material as claimed in claim 20, wherein M1 is Sr and x is in the range from 0.5 and 0.75.

26. An optical lithography crystal material as claimed in claim 20, wherein M2 is Ba and x is in the range from 0.5 and 0.75.

27. An optical lithography crystal material as claimed in claim 20, wherein M1 is Sr.

28. An optical lithography crystal material as claimed in claim 20, wherein M2 is Ba.

29. An optical lithography crystal material as claimed in claim 20, wherein M1 is Sr and M2 is Ca.

30. An optical lithography crystal material as claimed in claim 20, wherein M1 is Ca and M2 is Ba.

31. A dispersion management optical lithography crystal for managing dispersion below 160 nm, said dispersion management optical lithography crystal comprised of an isotropic alkaline earth metal lanthanum mixed crystal, said alkaline earth metal lanthanum mixed crystal material having a formula of $M_{1-x}R_xF_{2+x}$ where M is a alkaline earth metal chosen from the alkaline earth metal group consisting of Ca, Sr, and Ba, and R is lanthanum, and x is no greater than 0.3 , and said alkaline earth metal lanthanum mixed crystal having a 157 nm transmission > 85% .

32. An optical lithography crystal material as claimed in claim 31, wherein M is Ca.

33. An optical lithography crystal material as claimed in claim 31, wherein M is Ba.

34. An optical lithography crystal material as claimed in claim 31, wherein M is Sr.

35. An optical lithography crystal material as claimed in claim 31, wherein M is Ca and $x = 0.28$.

36. An optical lithography crystal material as claimed in claim 31, wherein M is Ba and $x = 0.26$.

37. An optical lithography crystal material as claimed in claim 31, wherein M is Sr and $x = 0.21$.

38. An optical lithography crystal material as claimed in claim 31, wherein x is in the range from 0.21 and 0.28.

39. A dispersion management optical lithography crystal comprised of an isotropic fluoride crystal, said fluoride crystal having a 157.6299 nm refractive index wavelength dispersion $dn/d\lambda < -0.003$ and a 157.6299 nm refractive index $n > 1.56$.

40. A dispersion management crystal as claimed in claim 39 wherein said crystal has a measured external 157 nm transmission $\geq 85\%$.

41. A below 160 nm optical lithography method comprised of

providing a below 160 nm optical lithography illumination laser,

providing a calcium fluoride crystal optical element,

providing a barium fluoride crystal optical element, said barium fluoride crystal element having a below 160 nm dispersion different from said calcium fluoride crystal,

transmitting below 160 nm optical lithography light through said calcium fluoride optical element and said barium fluoride optical element to form an optical lithography pattern with said barium fluoride crystal element below 160 nm dispersion correcting said calcium fluoride crystal dispersion..

42. A method as claimed in claim 41 wherein said barium fluoride crystal element has a below 160 nm chromatic dispersion different from said calcium fluoride crystal below 160 nm chromatic dispersion.

43. A method as claimed in claim 41 wherein said barium fluoride crystal element has a below 160 nm spatial dispersion different from said calcium fluoride crystal below 160 nm spatial dispersion.

44. A method as claimed in claim 41 wherein said barium fluoride crystal element has a below 160 nm wavelength dependent dispersion different from said calcium fluoride crystal below 160 nm wavelength dependent dispersion.

45. A below 160 nm optical lithography method comprised of

providing a below 160 nm optical lithography illumination laser,

providing a calcium fluoride crystal optical element,

providing a dispersion management fluoride crystal optical element, said dispersion management fluoride crystal element having a dispersion different from said calcium fluoride crystal,

transmitting below 160 nm optical lithography light through said calcium fluoride optical element and said dispersion management fluoride crystal optical element to form an optical lithography pattern with said dispersion management fluoride crystal optical element dispersion correcting said calcium fluoride crystal dispersion.

46. A method as claimed in claim 45 wherein providing a dispersion management fluoride crystal optical element includes:

loading a dispersion management fluoride crystal feedstock into a container,

melting said fluoride crystal feedstock to form a precrystalline fluoride melt,

progressively freezing said fluoride melt into a dispersion management fluoride crystal,

heating said fluoride crystal and thermal equilibrium cooling said dispersion management crystal,

forming said dispersion management fluoride crystal into an dispersion management optical element.

47. A below 160 nm optical lithography method comprised of

providing a below 160 nm optical lithography illumination laser,

providing a dispersion management fluoride crystal optical element, said dispersion management fluoride crystal element having a below 160 nm dispersion different from a calcium fluoride crystal,

transmitting below 160 nm optical lithography light through said dispersion management fluoride crystal optical element to form an optical lithography pattern.

48. A method as claimed in claim 47 wherein said dispersion management fluoride crystal element has a below 160 nm chromatic dispersion different from calcium fluoride crystal below 160 nm chromatic dispersion.

49. A method as claimed in claim 47 wherein said dispersion management fluoride crystal element has a below 160 nm spatial dispersion different from calcium fluoride crystal below 160 nm spatial dispersion.

50. A method as claimed in claim 47 wherein said dispersion management fluoride crystal element has a below 160 nm wavelength dependent dispersion different from a calcium fluoride crystal below 160 nm wavelength dependent dispersion.

51. A method of making a dispersion managing optical lithography element, said method comprising:

providing a source material containing barium fluoride,

melting said source material containing barium fluoride to form a precystalline melt containing barium fluoride,

solidifying said melt containing barium fluoride into an isotropic fluoride crystal containing barium fluoride,

annealing said crystal containing barium fluoride to provide an isotropic fluoride crystal containing barium fluoride .

52. A method of making a dispersion managing optical lithography crystal for correcting calcium fluoride at 157 nm, said method comprising:

providing a dispersion correction fluoride material,

melting said dispersion correction fluoride material to form a precystalline fluoride dispersion correction material melt,

solidifying said fluoride dispersion correction material melt into a dispersion correction material fluoride crystal,

annealing said dispersion correction material fluoride crystal to provide an isotropic dispersion correction material fluoride crystal with a 157 nm transmission > 80%.